REMARKS

Claims 1-5, 8-14 and 16-21 appear in this application for the Examiner's review and consideration. Claims 1 and 19 were amended to more clearly recite the claimed invention. Claim 21 has been newly added. These changes and additions do not raise any new issues or new matter. For the reasons that follow, applicants submit that the present claim amendments overcome all rejections and place the entire application in condition for allowance.

The present claims are directed to the thinning of wafers using implantation in the rear face of the semiconductor material to remove material from the rear face and to have very thin self supported layers (see, e.g., specification paragraphs [0022] and [0030]) for supporting electronic components or circuits without damaging devices formed on the front face. Furthermore, to assist in the thinning of the rear face, a stiffener is applied to the second face of the wafer prior to removing the remaining portion.

Claims 1-5, 8-14 and 16-19 were rejected as being indefinite. Independent claims 1 and 19 have been amended to more clearly recite the claimed invention and withdrawal of the rejection is respectfully requested.

Claim 19 was rejected as being unpatentable over Matsui et al. (U.S. Patent No. 6,191,007; "Matsui") in view of Tayanaka (U.S. Patent No. 6,107,213; "Tayanaka").

Matsui describes a method for transferring extremely thin patterned layers on a support. In most of the embodiments, an implantation is realized on the front face of the substrate that includes the components, and this face is masked to homogenize the thickness of the extremely thin layer that is transferred onto the support.

Matsui teaches ion implantation, thereby forming a hydrogen high-concentration layer 7 (Figures 2A- 2B). Matsui teaches that attachment of a supporting substrate 8 to the face with the electronic circuitry (Figures 2B), and then transfer of the circuitry to the supporting substrate 8 (Figure 2C). Contrary to the claimed invention, Matsui not only fails to teach or suggest a method for thinning a wafer with circuitry, but it does not teach or suggest implanting atomic species and applying a stiffener to a face opposite electronic components of circuits, and then removing the stiffener and a remaining portion to thin a wafer. It's method transfers the circuitry instead of thinning its wafer. The Examiner states that Matsui fails to teach a stiffener as instantly claimed. Furthermore, the attachment

and detachment of the stiffener as claimed, provides the surprising benefit that it allows a portion of the wafer to be removed at one time and this is a faster and more effective removal of material compared to polishing or scrubbing.

Tayanaka fails to remedy the deficiencies of Matsui. Tayanaka teaches application of a binder 14 and a support substrate 15 which are two separate and distinct materials (Fig. 3C; col. 15, lines 22-45). Binder 14 and support substrate 15 cannot, whether alone or taken together, constitute the claimed stiffener. The claimed stiffener is applied to the second face of the wafer. In contrast, layer 15 of Tayanaka is not applied to any surface of a wafer, but instead substrate 15 is itself applied to binder 14. Also, binder 14 is not applied to the rear face of a wafer prior to separating the substrate along a zone of weakness. Instead, binder 14 is coated on an epitaxial film prior to adhering support substrate 15 to binder 14 Tayakana also fails to teach or suggest removal of either binder 14 or support substrate 15 such that a freestanding self-supported thin layer is formed. Instead of thinning a wafer, the semiconductor substrate 11 taught by Tayanaka remains unchanged in thickness (Figs. 3A-3D). Moreover, the structures taught by Tayakana are not self-supporting thin layers, but instead the substrate 11 and film 13 taught by Tayanaka each remain attached to binder 14 and a support substrate (see Figs. 3C-3D; col. 15, lines 22-45). Tayanaka thus fails to teach or suggest application and removal of a stiffener to thin a wafer.

There is also motivation for a skilled artisan to apply either the binder 14 or the support substrate 15 of Tayanaka to the structure taught by Matsui. As discussed above, Matsui teaches detachment of a substrate at a weakened zone, where the transferred layer is always present with a supporting structure. Tayanaka teaches that binder 14 and support substrate 15 are applied to a semiconductor substrate 11 and to an epitaxial film 13. However, for the reasons discussed above, the combination of Matsui and Tayanaka falls short and does not teach or suggest the claimed invention which requires implanting through the rear face of a wafer, applying a stiffener to the rear face, and removing the stiffener as claimed. Tayanaka therefore fails to remedy the deficiencies of Matsui, in which Matsui's thin transferred layer also cannot be self-supporting, for the reasons discussed above.

Accordingly, the obviousness rejection based on Matsui in view of Tayanaka has been overcome and should be withdrawn.

Claims 1-4, 7-11, 16-18 and 20 were rejected as being unpatentable over the combination of Matsui in view of Tayanaka, as applied to claim 19, and further in view of Hanson et al. (U.S. Patent No. 5,920,764; "Hanson") for the reasons set forth on pages 3-4 of the action. Although claim 7 was rejected, this appears to be an error as claim 7 was previously canceled. Applicants submit that this rejection should be withdrawn in view of the following remarks.

Matsui and Tayanaka are described above and applicants adopt those comments in response to this rejection. Even in combination, for the reasons discussed above, Matsui and Tayanaka in combination still fall short of teaching or suggesting the claimed invention, which requires implanting through the rear face of a wafer, applying a stiffener to the rear face, and removing the stiffener as claimed. Hanson is apparently cited to remedy the deficiencies of Matsui and Tayanaka.

Hanson describes a method of reclaiming donor substrates using a number of techniques including the well known SMART-CUT® process (see col. 3, lines 55-58). The rejected wafers are submitted to different processing steps for removing unwanted layers and then are thinned by chemical etching (see col. 3, lines 59-61) to remove metals and insulators; planarization (see col. 4, lines 7-19) to smooth the surface; and detachment of layers with the steps of the conventional SMART-CUT ® process (i.e., implantation, heating and detaching) for removing diffusion and buried oxides (see col. 4, lines 2-37).

Hanson is directed to the re-processing of defective or rejected wafers so that the wafers can be reused. Even though Hanson discloses that the different steps of the SMART-CUT® process can be repeated to remove layers (col. 4, lines 37-41), he explains that it is the conventional SMART-CUT ® process that is used, and skilled artisans readily understand that this means that the implantation occurs on the front face of the substrate not on the rear face as presently claimed. Furthermore, in the SMART-CUT ® process, a stiffener is applied to the front face of the wafer, and Hanson could not remove defective material with that process if the stiffener is applied to the rear (or second) face of the wafer.

Furthermore, if a stiffener is to be provided onto the front face of the wafer, this would have to be on top of the electronic circuit (when one is provided), and this presents a number of problems. If the stiffener is to be molecularly bonded, the electronic circuit must also be polished to be sufficiently smooth to bond to the stiffener. If an adhesive is to be

used, the removal of the adhesive must be done carefully to avoid damage to the electronic circuit during such removal. The stiffener simply protects the circuit but does nothing to thin the layer that supports the electronic circuit.

There also is no motivation for a skilled artisan to implant ions into the rear face of the substrate and to apply a stiffener on that face as presently claimed, and the skilled artisan would not have used Hanson's disclosure for this purpose. Instead of thinning a wafer on its rear face for forming a thin self supporting layer with electronic components or circuits, Hanson is removing such a layer because it contains defective material. As Hanson does not remedy the deficiencies of Matsui and Tayanaka, this rejection should be withdrawn.

Furthermore, claim 21 defines a method of thinning a wafer wherein the reduced thickness is less than 35 μm. None of the references teach or suggest the invention as recited in claim 21.

Claims 5,and 12-14 were rejected over the prior combination with the addition of various selections of further references, including Henley et al. (U.S. Patent 6,291,314; "Henley"); Kang et al. (U.S. Patent 6,287,941; "Kang"); Aspar et al. (U.S. Patent 6,020,252; "Aspar"); Sayyah (U.S. Patent Application 2002/0055237; "Sayyah"); and Nuyen (U.S. Patent 5,827,751; "Nuyen"). Applicants note that claims 6 and 15 were previously cancelled, and the rejection therefore does not apply to these claims. None of these references remedy the deficiencies of Matsui, Tayanaka and Hanson as to independent claims 1, 19 or 20.

Henley describes a method for fabricating a film with active devices by transferring the layer from a donor substrate to a target substrate. In the same manner as the SMART-CUT® process, implantation of energetic species is realized through the front surface of the donor substrate (see col. 2, lines 50 and col. 13, lines 6-13). And to the extent that a stiffener is used, it is also applied to the front face after implantation.

Kang describes a method for treating a cleaved surface and or implanted surface with the combination of a thermal treatment and a chemical reaction. As the surface is cleaved, it does not include a temporary stiffener as in the present invention.

Aspar discloses the separation of a thin layer having electronic components from a substrate using implantation, heat treatment and mechanical forces. The implantation again occurs on the front face of the substrate (see Fig. 1 and col. 4 lines 19-21) and both the

thin layer and stiffener which is applied on that same face are subsequently separated from the substrate by heating.

Sayyah describes the transfer of prefabricated devices and circuits from a original substrate to a new substrate.

Nuyen describes epitaxially growing on a substrate a separating layer and dissolving the separating layer by chemical action.

The independent claims recite the application of a stiffener to the face of the wafer that is desired to be thinned. Matsui has no such disclosure, and none of the secondary references supply this missing disclosure. The combination of cited references does not result in the presently claimed invention, and these secondary rejections based on these combinations of references should be withdrawn.

Accordingly, it is believed that the entire application is now in condition for allowance, early notice of which would be appreciated. Should the Examiner disagree, then a personal or telephonic interview is respectfully requested to discuss any remaining issues and expedite the eventual allowance of the application.

Respectfully submitted,

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